Project Risk Register

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Revision History

Issue Date	Version	Authors	Approver
Dec. 15, 2009	1	Jonathan Bown, Leslie Warren	Rich Lewis

Description
First Version

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Risk Type	Risk Category	Likelihood
Requirement	Cost	Very Low
Design	Schedule	Low
Deliverable	Cost & Schedule	Medium
Personnel	Scope	High
Communication	Quality	Very High

CES Project Preliminary Risk Register

Client: Clean Energy Systems (CES)
Project Name: NAM-NAL_RCG_SIS_USCL_CES_ Preliminary EPA UIC Class VI Permit for 6 sites 2019-2020
Project Id: 2019-PRJ-0553
Contract Number: 1-1K8MBPT

Identification					
Risk Number	Date Identified	Identified By	Project Phase	Description of Risk	Risk Trigger(s)
1a		SLB	Drilling	Over-pressurized fluid (blowout) during well construction	1. Pocket of high pressure gas or fluid encountered during drilling.
2a		SLB	Injecting/Monitoring	Injection or monitoring (verification) well integrity failure	1. Wellhead pressure exceeds the specified shutdown pressure specified in the permit.
2b		SLB	Injecting/Monitoring	Injection or monitoring (verification) well integrity failure	1. Annulus pressure indicates a loss of external or internal well containment.
2c		SLB	Injecting/Monitoring	Injection or monitoring (verification) well integrity failure	1. Mechanical integrity test results identify a loss of mechanical integrity.

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Risk Level	
Black	**Extreme:** Stop the tasks/processes. Significant Action Plan requ
Red	**High:** Significant Action Plan required.
Yellow	**Medium:** Action Plan required.
Green	**Low:** Proceed carefully. Action Plan may but warranted but not re
Blue	**Insignificant:** Safe to proceed. Action Plan not required.

Qualitative Analysis								Risk Response						
Severity	**Risk Matrix**							**Strategy**	**Strategy Action Plan/Response Plan**	**Category**	**Assigned to**	**Avoidance Measures**	**Respons**
Catastrophic			**Likelihood**					Mitigation	Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Cease drilling operations: loss of drilling fluid due to lost circulation and/or drilling into an over-pressured formation.	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Projec
	Severity	Light						Mitigation	Initiate well control procedures (see well plan).	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Projec
		Serious						Mitigation	Close flow valve (blowout preventer) if considered appropriate not to damage well and USDW.	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Projec
		Major						Mitigation	Regain pressure control by restoring fluid levels in the wellbore with appropriate density mud, restriction of flow through choke or both.	Major/Serious/Minor	Well Eng.	Monitoring	Well Eng., Projec
		Catastrophic	X					Mitigation	Alert local fire and police and UIC Program Director immediately.	Major/Serious	Well Eng.	Monitoring	Well Eng., Projec
		Multi-Catastrophic						Mitigation	Determine cause of event and initiate remediation procedures.	Minor	Well Eng.	Monitoring	Well Eng., Projec
								Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Projec
Light			**Likelihood**						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Major/Serious, Minor	Well Eng., Project Mgr.	Monitoring	Well Eng., Projec
	Severity	Light		X				Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.
		Serious						Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator
		Major						Mitigation	Shut in well (close flow valve). After verifying pressures will not damage well or USDW	Major/Serious	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause, location and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Eng	Monitoring	Well Eng
		Multi-Catastrophic						Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator
								Mitigation	Evaluate, test sensors to determine they are functioning properly. If sensors are determined faulty or in need of maintenance commence repair/replacement operations. (in consultation with the UIC Program Director restart injecton).	Minor	Site Operator	Maintenance	Site Operator
								Mitigation	Vent fluids, if needed to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Major/Serious	Site Operator	Monitoring	Site Operator
								Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Project Mgr.	Monitoring	Project Mgr.
								Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Eng/Site Operator	Monitoring	Well Eng
								Mitigation	If there has been a loss of mechanical integrity, initiate shutdown plan. Provided there is sufficient mechanical intergrity to contain pressures. May need to allow Packer fluid into reservoir and keep well full with fluid in mechanical integrity permits.	Minor	Well Eng/Site Operator	Monitoring	Well Eng
								Mitigation	Reset automatic shutdown devices.	Minor	Site Operator	Monitoring	Site Operator
								Mitigation	If a shut off is triggered by mechanical or electrical malfunctions without endangering a USDW, repair faulty components. electrical malfunctions without endangering a USDW, repair faulty components. Verify with analog gauges.	Minor	Well Eng., Project Mgr.	Monitoring/Maintenance	Well Eng., Projec
Serious			**Likelihood**						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Project Mgr.		Project Mgr.
	Severity	Light						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.
		Serious		X				Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator
		Major						Mitigation	Shut in well (close flow valve). After verifying pressures will not damage well or USDW. Allow packer fluid into reservoir to stop CO2 flow and keep well full with proper density fluid if required.	Major/Serious	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Vent fluids, if needed, to maintain reasonable wellbore and surface facilities pressures.	Major/Serious	Site Operator	Monitoring	Site Operator
		Multi-Catastrophic						Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr.	Monitoring	Well Engineer
								Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Vent fluids f from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Minor	Site Operator	Monitoring	Site Operator
								Mitigation	Reset automatic shutdown devices.	Minor	Site Operator	Monitoring	Site Operator
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If a shut off is triggered by mechanical or electrical malfunctions without endangering a USDW, repair faulty components. electrical malfunctions without endangering a USDW, repair faulty components. Verify with analog gauges.	Minor	Site Operator	Monitoring/Maintenance	Site Operator
Catastrophic			**Likelihood**						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Project Mgr.		Project Mgr.
	Severity	Light						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.
		Serious						Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator
		Major						Mitigation	Shut in well (close flow valve). After verifying pressures will not damage well or USDW. Need to verify best method to shut in well so that the mechanical integrity issues are not a factor such as allowing packer fluid to flow to reservoir and keep well full of liquid.	Major/Serious	Site Operator	Monitoring	Site Operator
		Catastrophic	X					Mitigation	Vent fluids if needed, to maintain reasonable wellbore and surface facilities pressures.	Major/Serious	Site Operator	Monitoring	Site Operator
		Multi-Catastrophic						Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr.	Monitoring	Well Engineer

3a		SLB	Injecting/Monitoring	Injection well monitoring equipment failure (e.g., shut-off valve or pressure gauge, etc.)	1. The failure of monitoring equipment for wellhead pressure, temperature, and/or annulus pressure may indicate a problem with the injection well that could endanger USDWs.
3b		SLB	Injecting/Monitoring	Injection well monitoring equipment failure (e.g., shut-off valve or pressure gauge, etc.)	1. Equipment failures (sensor, computer, cabling, etc) and damage to wellhead (ran over by heavy equipment).
4a		SLB	Throughout	Fluid (e.g. brine) leakage to a USDW	1. Any evidence of fluid movement out of the injection zone (i.e., not necessarily to a USDW) to address unanticipated events associated with faults or other pathways; any potential USDW endangerment/unacceptable changes in water quality; and CO2 leakage to the land surface.

								Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Reset automatic shutdown devices.	Minor	Site Operator	Monitoring	Site Operator
								Mitigation	If there is damage to the wellhead, repair the damage and conduct a survey to ensure wellhead leakage has ceased.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Confirm well integrity prior to restarting injection (upon approval of the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Review downhole, wellhead, and annulus pressure data.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	Perform a well log/MIT to detect CO2 movement outside of the casing.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	If a shut off is triggered by mechanical or electrical malfunctions without endangering a USDW, repair faulty components. electrical malfunctions without endangering a USDW, repair faulty components. Verify with analog gauges.	Minor	Site Operator	Monitoring/Maintenance	Site Operator
Light			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Project Mgr.	Monitoring	Project Mgr.
	Severity	Light			X			Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.
		Serious						Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator
		Major						Mitigation	Shut in well (close flow valve). Allow packer fluid into reservoir to stop CO2 flow and keep well full with proper density fluid if required.	Major/Serious	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Vent fluids, if needed, to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Major/Serious	Site Operator	Monitoring	Site Operator
		Multi-Catastrophic						Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator
								Mitigation	Verify pressures and temperatures with analog guages.				
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr.	Monitoring	Well Engineer, Pr
								Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Shut in well (close flow valve). Allow packer fluid into reservoir to stop CO2 flow and keep well full.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Vent fluids f from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Reset automatic shutdown devices.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If there is damage to the wellhead, repair the damage and conduct a survey to ensure wellhead leakage has ceased.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Confirm well integrity prior to restarting injection (upon approval of the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Review downhole, wellhead, and annulus pressure data.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	Perform a well log/MIT to detect CO2 movement outside of the casing.	Major/Serious	Well Engineer	Monitoring	Well Engineer
Catastrophic			Likelihood						Limit access to wellhead to authorized personnel only		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Project Mgr.	Monitoring	Project Mgr.
	Severity	Light						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.
		Serious						Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator
		Major						Mitigation	Shut in well (close flow valve). Allow packer fluid into reservoir to stop CO2 flow and keep well full with proper density fluid.	Major/Serious	Site Operator	Monitoring	Site Operator
		Catastrophic	X					Mitigation	Vent fluids f from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing, if possible	Major/Serious	Site Operator	Monitoring	Site Operator
		Multi-Catastrophic						Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr.	Monitoring	Well Engineer, Pr
								Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Reset automatic shutdown devices.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	If there is damage to the wellhead, repair the damage and conduct a survey to ensure wellhead leakage has ceased.	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Confirm well integrity prior to restarting injection (upon approval of the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer
								Mitigation	Review downhole, wellhead, and annulus pressure data.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious	Well Engineer	Monitoring	Well Engineer
								Mitigation	Perform a well log/MIT to detect CO2 movement outside of the casing.	Major/Serious	Well Engineer	Monitoring	Well Engineer
Catastrophic			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Project Mgr.
	Severity	Light						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Project Mgr.
		Serious						Mitigation	Initiate shutdown of plant.	Major/Serious/Minor	Site Operator	Monitoring	Site Operator
		Major							If the presence of indicator parameters is confirmed, develop (in consultation with the UIC Program Director) a case-specific work plan to:		Site Operator	Monitoring	Project Mgr.
		Catastrophic	X					Mitigation	Install additional groundwater monitoring points near the affected groundwater well(s) to delineate the extent of impact; and	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
		Multi-Catastrophic						Mitigation	Remediate unacceptable impacts to the affected USDW.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Arrange for an alternate potable water supply, if the USDW was being utilized and has been caused to exceed drinking water standards.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Proceed with efforts to remediate USDW to mitigate any unsafe conditions (e.g., install system to intercept/extract brine or CO2or "pump and treat" to aerate CO2-laden water).	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Continue groundwater remediation and monitoring on a frequent basis (frequency to be determined by Clean Energy Systems and the UIC Program Director) until unacceptable adverse USDW impact has been fully addressed.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Address a well integrity issue, including taking specific steps to identity the location of the failure/leak, affect repairs, and demonstrate MI.	Major/Serious/Minor	Well Eng., Project Mgr.	Monitoring	Well Eng., Projec
								Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious/Minor	Site Operator	Monitoring	Air monitoring
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Project Mgr.
	Severity	Light						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Project Mgr.
		Serious						Mitigation	Initiate immediate shutdown plan.	Major/Serious/Minor	Site Operator	Monitoring	Site Operator
		Major							If the presence of indicator parameters is confirmed, develop (in consultation with the UIC Program Director) a case-specific work plan to:		Site Operator	Monitoring	Project Mgr.
		Catastrophic	X					Mitigation	Install additional groundwater monitoring points near the affected groundwater well(s) to delineate the extent of impact; and	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant

4b		SLB	Throughout	Fluid (e.g. CO2) leakage to a USDW	1. Any evidence of CO2 movement out of the injection zone (i.e., not necessarily to a USDW) to address unanticipated events associated with faults or other pathways; any potential USDW endangerment/unacceptable changes in water quality; and CO2 leakage to the land surface.
5a		SLB	Throughout	A natural disaster (e.g., earthquake, tornado, lightning strike)	1. Well problems (integrity loss, leakage, or malfunction) may arise as a result of a natural disaster affecting the normal operation of the injection well. An earthquake may disturb surface and/or subsurface facilities; and weather-related disasters (e.g., tornado or lightning strike) may affect surface facilities.
6a		SLB	Throughout or injection	Induced or natural seismic event	1. Injection operation inducing a seismic event equal to or less than M1.5
6b		SLB	Throughout or injection	Induced or natural seismic event	1. Five (5) or more seismic events within a 30-day period having a magnitude greater than M1.5 but less than or equal to M2.0
6c		SLB	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M1.5 and local observation or felt report.
6c		SLB	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M2.0 and no felt report
6d		SLB	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M2.0 and local observation or report

Catastrophic		Multi-Catastrophic						Mitigation	Remediate unacceptable impacts to the affected USDW.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Arrange for an alternate potable water supply, if the USDW was being utilized and has been caused to exceed drinking water standards.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Proceed with efforts to remediate USDW to mitigate any unsafe conditions (e.g., install system to intercept/extract brine or CO2or "pump and treat" to aerate CO2-laden water).	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Continue groundwater remediation and monitoring on a frequent basis (frequency to be determined by Clean Energy Systems and the UIC Program Director) until unacceptable adverse USDW impact has been fully addressed.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant
								Mitigation	Address a well integrity issue, including taking specific steps to identity the location of the failure/leak, affect repairs, and demonstrate MI.	Major/Serious/Minor	Well Eng., Project Mgr.	Monitoring	Well Eng., Projec
								Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious/Minor	Site Operator	Fence	Air monitoring
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Site Operator
	Severity	Light						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Site Operator
		Serious						Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Preventative Operation	Site Operator
		Major						Mitigation	Shut in well (close flow valve).	Major/Serious/Minor	Site Operator	Preventative Operation	Site Operator
Catastrophic		Catastrophic		X				Mitigation	Vent CO2 from surface facilities if appropriate.	Major/Serious/Minor	Site Operator	Preventative Operation	Site Operator
		Multi-Catastrophic						Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious		Monitoring	
								Mitigation	Determine if any leaks to ground water or surface water occurred.	Major/Serious	GW Consultant	Monitoring	GW Consultant
								Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	GW Consultant	Remedial Action	GW Consultant
								Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Site Operator	Monitoring	Site Operator
								Mitigation	If there has been a loss of mechanical integrity, initiate shutdown plan.	Minor	Site Operator	Remedial Action	Site Operator
								Mitigation	If there has not been a loss of mechanical integrity, initiate gradual shutdown.	Minor	Site Operator	Remedial Action	Site Operator
								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Site Operator	Monitoring	Site Operator
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Site Operator
	Severity	Light			X								
		Serious						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).		Site Operator	Monitoring	Site Operator
		Major											
Light		Catastrophic						Mitigation	Continue normal operation within permitted levels.	Minor	Site Operator		Site Operator
		Multi-Catastrophic						Mitigation	Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator		Site Operator/Mic
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High						
	Severity	Light			X			Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Site Operator
		Serious											
		Major						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Continue normal operation within permitted levels.	Minor	Site Operator		Site Operator
Light		Multi-Catastrophic						Mitigation	Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator		Site Operator
									Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.	Minor	Microseismic provider		Site Operator
									Report findings to the UIC Program Director and issue corrective actions.	Minor	Site Operator		Site Operator
									Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator		Site Operator/Mic
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High						
	Severity	Light						Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Site Operator
		Serious											
		Major			X			Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Continue normal operation within permitted levels.	Minor	Site Operator		Site Operator
Major		Multi-Catastrophic						Mitigation	Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator		Site Operator
									Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.	Minor	Microseismic provider		Site Operator
									Report findings to the UIC Program Director and issue corrective actions.	Minor	Site Operator		Site Operator
									Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator		Site Operator/Mic
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High						
	Severity	Light		X				Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Site Operator
		Serious											
		Major						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Continue normal operation within permitted levels.	Minor	Site Operator		Site Operator
Light		Multi-Catastrophic						Mitigation	Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator		Site Operator
									Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.	Minor	Microseismic provider		Site Operator
									Report findings to the UIC Program Director and issue corrective actions.	Minor	Site Operator		Site Operator
									Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator		Site Operator/Mic
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High						
	Severity	Light						Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator	Monitoring	Site Operator
		Serious											
		Major		X				Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator	Monitoring	Site Operator
		Catastrophic						Mitigation	Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator		Site Operator
		Multi-Catastrophic						Mitigation	Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary.	Minor	Site Operator	Monitoring	Site Operator
Major								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure; identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Minor	Site Operator		Site Operator
								Mitigation	Determine if leaks to ground water or surface water or a CO2 leak to the surface occurred.	Major/Serious	GW Consultant		GW Consultant
								Mitigation	If a CO2 leak or USDW contamination/endangerment is detected: Notify the UIC Program Director within 24 hours of the determination and implement appropriate remedial actions in consultations with the Director.		Site Operator		Site Operator
								Mitigation	Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.		Microseismic provider		Site Operator
								Mitigation	Report findings to the UIC Program Director and issue corrective actions.		Site Operator		Site Operator
									Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator		Site Operator/Mic
			Likelihood						Limit access to wellhead to authorized personnel only.		Site Operator	Signage	Site Operator
			Very Low	Low	Medium	High	Very High						
	Severity	Light						Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.		Site Operator		Site Operator
		Serious											

6e		SLB	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M2.0,and local observation or report, andlocal report and confirmation of damage .	2. Seismic event >M3.5

	Sever	Major						Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Site Operator		Site Operator
		Catastrophic		X				Mitigation	Initiate immediate shutdown plan.	Minor	Site Operator		Site Operator
		Multi-Catastrophic						Mitigation	Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary.	Minor	Site Operator		Site Operator
Catastrophic								Mitigation	Monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure; identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Minor	Site Operator		Site Operator
								Mitigation	Determine if leaks to ground water or surface water or a CO2 leak to the surface occurred.	Major/Serious	GW Consultant		GW Consultant
								Mitigation	If a CO2 leak or USDW contamination/endangerment is detected: Notify the UIC Program Director within 24 hours of the determination and implement appropriate remedial actions in consultations with the Director.		Site Operator		Site Operator
								Mitigation	Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.		Microseismic provider		Site Operator
								Mitigation	Report findings to the UIC Program Director and issue corrective actions.		Site Operator		Site Operator
									Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator		Site Operator/Mic

[File]

Preliminary Risk Register

The likelihood and severity were defined based upon knowledge of the area, previous project experience, and domain knowledge.
A meeting was held amongst the team where consensus was reached as to the likelihood and severity levels.
As the project progresses, the risk register will be updated to reflect the current risk scenarios and incorporate residual risk based upon the response plan.
When reviewing the scenario the highest risk level was assigned.

Scales of Sev		
For each scenario, we evaluate Severity first, and th		
is the m		

Ranking Factor		
5	**Multi-Catastrophic**	Multiple fatalities and/or d
4	**Catastrophic**	One fatality and/or damage
3	**Major**	Injury causing permanent d suspension and/or area eva
2	**Serious**	Injury causing temporary di
1	**Light**	Minor injury or illness and/

Ranking Factor		
5	**Very High**	Scenario occurs every few
4	**High**	Scenario occurs every few
3	**Medium**	Scenario occurs every centu
2	**Low**	Scenario occurs every few
1	**Very Low**	Scenario unlikely to occur.

Risk Level	
Black	**Extreme:** Stop the tasks/processes. Significant Action Plan requir
Red	**High:** Significant Action Plan required.
Yellow	**Medium:** Action Plan required.
Green	**Low:** Proceed carefully. Action Plan may but warranted but not req
Blue	**Insignificant:** Safe to proceed. Action Plan not required.

Risk Type			Li	
			Very Low	Low
Severity	Light			
	Serious			
	Major			
	Catastrophic			
	Multi-Catastrophic			

erity and Likelihood (probability)
to 25.
ıen judge the Likelihood that negative impacts of that Severity will occur.
ost applicable for the scenario.

Severity of Negative Impact (S)
amages exceeding $100M and/or project shut down.
s $10M-$100M and/or project lost time greater than 1 year.
lisability and/or damages exceeding $1M to $10M and/or project lost time greater than 1 month and/or permit acuation.
isability and/or damages $100k to $1M and/or project lost time greater than 1 week and/or regulatory notice.
or damages less than $100k and/or project lost time less than 1 week.

Likelihood of Impact or Failure Occurring (L)
years, or more often. Nearly certain to happen during the project.
decades. Probably will happen during the project.
ury.
centuries.

ed.
uired.

kelihood		
Medium	High	Very High

Fluid Leakage			Likelihood				
			Very Low	Low	Medium	High	Very High
Severity	Light						
	Serious						
	Major						
	Catastrophic						
	Multi-Catastrophic						

At this time all the pull down lists are called on from the Risk Register Tab, hidden rows 2-8

Risk Type
Drilling
Natural
Seismic
Equipment
Leakage

Risk Category	Likelihood	Severity	Strategy	Status	Avoidance Measures
Cost	Very Low	Light	Avoidance	Open	Monitoring
Schedule	Low	Serious	Transference	In Progress	Maintenance
Cost & Schedule	Medium	Major	Mitigation	Resolved	Monitoring/Maintenance
Scope	High	Catastrophic	Acceptance	Closed	
Quality	Very High	Multicatastrophic	Not Applicable	On Hold	
HS				No Longer Threat	
Environmental					